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State-of-the-Art Reviews

Sadness, counseling for sadness, and sleep time and COVID-19 pandemic in South Korea: Rapid review and a post-hoc analysis

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Abstract

The COVID-19 pandemic has had a significant and detrimental impact on daily life. However, research on the prevalence and pandemic-related risk factors of sadness, sadness-related counseling, and sleep duration remains limited. The aim of this review paper was to examine the association of the COVID-19 pandemic on the prevalence of sadness, counseling for sadness, and sleep time by analyzing 13-year trends using data from a nationally representative survey of three million adults. We used nationwide and large scaled 2,842,431 Korean adult data. The prevalence of sadness, counseling for sadness, and sleep time were evaluated with 95% confidence interval and the trend was compared before and during the COVID-19 pandemic. During the period of 2009 to 2021, a total of 2,842,431 individuals in South Korea were included in the study (1,320,239 [46.4%] male; 19-39 years, 746,572 [26.3%]). The prevalence of sadness remained stable before the pandemic, but the slope was positive during the pandemic, showing an increase in total prevalence during the pandemic (βdiff, 0.022; 95% CI, 0.015-0.030). However, the prevalence of individuals who had been counseled for sadness gradually increased less than expected during the pandemic (βdiff, -0.062; 95% CI, -0.078 to -0.046). The average sleep time of Korean adults showed a decline before the pandemic, but increased during the pandemic (βdiff, 0.023; 95% CI, 0.022-0.024). This is the first long-term, large-scale, and population-based study to comprehensively analyze the changes in prolonged trends of sadness, counseling for sadness, and sleep time among adults before and during the COVID-19 pandemic. Our research suggests that, during the pandemic, individual policy strategy for the psycho-physiological aspect should be addressed as a public issue.

Keywords: COVID-19, pandemic, depression, counseling for depression, South Korea

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1. Introduction

The coronavirus disease 2019 (COVID-19) pandemic emerged approximately three years ago, at the time of writing, and has substantially changed the lives of individuals. Among many other pandemic-related health outcomes, mental health of individuals has been substantially and on the whole negatively affected[1, 2]. Indeed, The World Health Organization announced that the prevalence of depression and anxiety increased by 25% globally during the first year of the COVID-19 pandemic. Importantly, appropriate counseling is essential for an early diagnosis and adequate care for patients with depression[3]. However, inadequate mental health services throughout the globe is indeed problematic for those who are vulnerable[4]. The COVID-19 pandemic has altered daily lives of populations and has had a detrimental impact on the well-being of individuals. Moreover, mental health complications and a deterioration in wellbeing has a detrimental impact on sleep parameters[5]. Whereas poor quality sleep has a detrimental impact on mental health and thus the mental health-sleep relationship is bidirectional[6]. Most of the studies were conducted in Asia, examining the changes of mental health comparing only the two separate years: 2019 and 2020[7, 8]. Furthermore, there are few studies examining counseling attendance for sadness during the pandemic and how it changed from before[9]. We published the preliminary results in Asian Journal of Psychiatry[10]. Hence, this study aimed to examine the three main variables: prevalence of sadness, counseling for sadness, and the average time of sleep, and their changes at the onset of the pandemic.

2. Methods

2.1 Data

We used the data from the 2009-2021 Korea Community Health Survey (KCHS) conducted by the Korea Disease Control and Prevention Agency (KDCA). The baseline characteristics, body measurements, and health-related data including depression status and average sleep time of adults 19 years or older living in South Korea between 2009 and 2019 were obtained via interview. Data were obtained from throughout Korea based on the region of residence, having an average sample size of 900 people per each community health center (total 235 centers)[11].

Of the 2,976,925 total participants, participants with incomplete height and weight information (n=103,010), incomplete body-mass index information (n=489), and incomplete average sleep time data (n=995) were excluded from this study. The Kyung Hee University (KHUH 2022-06-042) and the KDCA approved the study protocol. This study was conducted in accordance with the principles of the Declaration of Helsinki and all participants signed a written informed consent form

2.2 Survey

Continuous variables used in this study were age, body mass index (BMI, kg/m^2), monthly household income and average sleep time. Categorical variables used were sex, educational background, region of residence, alcohol consumption, smoking status, occupation group, and marital status. The study stratified and included the specific variables as follows: age (19 to 39,

40 to 59, and ≥60 years), monthly household income (less than 3 million won, 3 million won or more, unknown; 3 million won is equivalent to about 2,200 US dollars), region of residence (urban areas [Seoul, Gyeonggi, Incheon, Daejeon, Sejong, Gwangju, Ulsan, Daegu, and Busan] and rural areas [Gangwon, Chungbuk, Chungnam, Jeonbuk, Jeonnam, Gyeongbuk, Gyeongnam, and Jeju]) [12, 13], alcohol consumption (0, 1-4, and 5-30 days/month), BMI group (underweight or normal [<23.0 kg/m^2], overweight or obese [≥23.0 kg/m^2]), education background (high school or less, and college or more), and occupational group (white-collar, blue-collar, and unknown).

2.3 Statistical analysis

We combined and defined two or three consecutive years (2009 to 2011, 2012 to 2014, 2015 to 2017, 2018 to 2019 and 2020 to 2021) to stabilize each estimate with a 95% confidence interval (CI). Subgroup analysis was performed separately by income, current smoking status, alcohol consumption, BMI group, education background, occupational group, and marital status. Statistical analyses were performed using the SPSS software (version 26; IBM Corp, Armonk, NY, USA). A two-sided p value <0.05 was considered statistically significant.

3. Results

During the period of 2009 to 2021, a total of 2,842,431 individuals in South Korea were included in the study (1,320,239 [46.4%] male; 19-39 years, 746,572 [26.3%]) (Table 1). Table 2 shows the changes in the prevalence of sadness among participants from 2009 to 2021. The positive change was estimated as 0.022 (95% CI, 0.015 to 0.030) calculated in β_{diff} from periods before and during the pandemic, indicating a significant increase in sadness. Counseling for sadness among participants, regarding the changes in trend is shown in Table 3. The overall average sleep time of adults was 6.773 hours (95% CI, 6.770 to 6.777) in the pandemic period (2020 to 2021). The increasing change in the trend was consistent in all of the subgroups (Table 4).

4. Discussion

4.1 Findings of our study

In contrast to the periods before the pandemic, the prevalence of sadness symptoms, counseling for sadness, and the average time of sleep among adults during the pandemic increased, decreased and increased, respectively. Rates of change were significant in all groups for the trend of counseling for sadness and average sleep time. For sadness, prevalence was shown to have increased significantly especially for the non-smoking and married populations. Finally, the pandemic increased the disparities in depression across smoking status, alcohol consumption, marriage, vigorous physical activity, and income groups.

Since the three variables, especially the average sleep time and sadness status of an individual are known to be closely related, this study aimed to find the change in trends of the variables in a nationwide scale. The COVID-19 pandemic has altered the sleep patterns and

Table 1. Baseline characteristics of adults in Community Health Survey, 2009-2021

	Number of participants, n (%)					
	Total	2009-2011	2012-2014	2015-2017	2018-2019	2020-2021
Age, years						
19-39	746,572 (26.3)	201,994 (30.6)	178,942 (27.6)	166,143 (25.4)	98,128 (22.8)	101,365 (22.6)
40-59	1,101,580 (38.8)	264,883 (40.2)	265,428 (41.0)	255,822 (39.0)	157,112 (36.5)	158,335 (35.2)
≥ 60	994,279 (35.0)	192,515 (29.2)	203,458 (31.4)	233,219 (35.6)	175,431 (40.7)	189,656 (42.2)
Sex						
Male	1,320,239 (46.4)	308,761 (46.8)	302,743 (46.7)	303,856 (46.4)	197,849 (45.9)	207,030 (46.1)
Female	1,522,192 (53.6)	350,631 (53.2)	345,085 (53.3)	351,328 (53.6)	232,822 (54.1)	242,326 (53.9)
Region of residence						
Urban	1,400,118 (49.3)	322,476 (48.9)	322,752 (49.8)	323,399 (49.4)	212,278 (49.3)	219,213 (48.8)
Rural	1,442,313 (50.7)	336,916 (51.1)	325,076 (50.2)	331,785 (50.6)	218,393 (50.7)	230,143 (51.2)
Monthly income						
< 3 million won	1,240,696 (43.6)	276,633 (42.0)	282,412 (43.6)	349,813 (53.4)	162,942 (37.8)	168,896 (37.6)
≥3 million won	1,103,691 (38.8)	186,409 (28.3)	239,772 (37.0)	299,322 (45.7)	191,229 (44.4)	186,959 (41.6)
Unknown	498,044 (17.5)	196,350 (29.8)	125,644 (19.4)	6049 (0.9)	76,500 (17.8)	93,501 (20.8)
Current smoking status						
No	2,283,921 (80.4)	508,517 (77.1)	510,832 (78.9)	533,308 (81.4)	355,777 (82.6)	375,487 (83.6)
Yes	558,510 (19.6)	150,875 (22.9)	136,996 (21.1)	121,876 (18.6)	74,894 (17.4)	73,869 (16.4)
Alcohol consumption, days/month						
0	1,350,954 (47.5)	317,491 (48.1)	303,185 (46.8)	304,665 (22.1)	210,045 (48.8)	215,568 (48.0)
1-4	833,378 (29.3)	203,369 (30.8)	201,152 (31.1)	202,627 (30.9)	126,831 (29.4)	99,399 (22.1)
5-30	658,099 (23.2)	138,532 (21.0)	143,491 (22.1)	147,892 (22.6)	93,795 (29.4)	134,389 (29.9)
BMI group, kg/m^2						
Under and normal (<23.0)	1,382,130 (48.6)	348,242 (52.8)	331,198 (51.1)	317,195 (48.5)	183,003 (42.5)	202,492 (45.1)
Over and obese (≥23.0)	1,460,301 (51.4)	311,150 (47.1)	316,630 (48.9)	337,989 (51.6)	247,668 (57.5)	246,864 (54.9)
Occupational group						
White-collar	560,735 (19.7)	123,918 (18.8)	130,035 (20.1)	132,609 (20.2)	84,139 (19.5)	90,034 (20.0)
Blue-collar	1,226,498 (43.1)	275,920 (41.8)	285,753 (44.1)	289,735 (44.2)	186,641 (43.3)	188,449 (41.9)

Table 1. Continued

	Number of participants, n (%)					
	Total	2009-2011	2012-2014	2015-2017	2018-2019	2020-2021
Unknown	1,055,198 (37.1)	259,554 (39.4)	232,040 (35.8)	232,840 (35.5)	159,891 (37.1)	170,873 (38.0)
Education						
≤High school	1,818,688 (64.0)	443,971 (67.3)	417,839 (64.5)	411,419 (62.8)	271,481 (63.0)	273,978 (61.0)
≥College	1,023,743 (36.0)	215,421 (32.7)	229,989 (35.5)	243,765 (37.2)	159,190 (37.0)	175,378 (39.0)
Marital status						
Married	1,993,239 (70.1)	473,058 (71.7)	465,832 (71.9)	459,194 (70.1)	297,013 (69.0)	298,142 (66.3)
Single	849,192 (29.9)	186,334 (28.3)	181,996 (28.1)	195,990 (29.9)	133,658 (31.0)	151,214 (33.7)
Sadness status						
No	2,669,749 (93.9)	619,656 (94.0)	609,600 (94.1)	614,335 (93.8)	405,436 (94.1)	420,722 (93.6)
Yes	172,682 (6.1)	39,736 (6.0)	38,228 (5.9)	40,849 (6.2)	25,235 (5.9)	28,634 (6.4)
Counseling for sadness						
No	2,810,464 (98.9)	653,189 (99.1)	641,411 (99.0)	647,824 (98.9)	425,359 (98.8)	442,681 (98.5)
Yes	31,967 (1.1)	6,203 (0.9)	6,417 (1.0)	7,360 (1.1)	5,312 (1.2)	6,675 (1.5)
Sleep time, hours/day, mean (SD)	6.65 (1.25)	6.71 (1.25)	6.63 (1.23)	6.56 (1.23)	6.63 (1.26)	6.77 (1.27)

Abbreviation: BMI, body mass index; CI, confidence interval.

Table 2. Nationwide trends in prevalence of sadness status from Korean adults in Community Health Survey, 2009-2021

	Before the pandemic				During the pandemic	Sadness trend, β (95% CI)		Trend difference, β_{diff} (95% CI)	Before and during the COVID pandemic, OR (95% CI)
	2009-2011	2012-2014	2015-2017	2018-2019	2020-2021	Before the pandemic	During the pandemic		2020-2021 versus 2018-2019
Overall	6.026 (5.969 to 6.084)	5.901 (5.844 to 5.958)	6.235 (6.176 to 6.293)	5.860 (5.789 to 5.930)	6.372 (6.301 to 6.444)	0.000 (-0.006 to 0.006)	0.022 (0.018 to 0.027)	**0.022 (0.015 to 0.030)**	**1.063 (1.049 to 1.077)**
Income									
< 3 million won	7.622 (7.523 to 7.721)	7.736 (7.637 to 7.834)	7.633 (7.545 to 7.721)	8.015 (7.883 to 8.146)	8.375 (8.243 to 8.507)	0.012 (0.005 to 0.020)	0.012 (0.006 to 0.018)	0.000 (-0.010 to 0.009)	**1.093 (1.073 to 1.114)**

Table 2. Continued

	Before the pandemic				During the pandemic	Sadness trend, β (95% CI)		Trend difference, β_{diff} (95% CI)	Before and during the COVID pandemic, OR (95% CI)
	2009-2011	2012-2014	2015-2017	2018-2019	2020-2021	Before the pandemic	During the pandemic		2020-2021 versus 2018-2019
≥ 3 million won	4.381 (4.288 to 4.474)	4.412 (4.330 to 4.494)	4.588 (4.513 to 4.663)	4.315 (4.224 to 4.406)	4.851 (4.754 to 4.949)	0.002 (-0.009 to 0.012)	0.031 (0.023 to 0.038)	**0.029 (0.016 to 0.042)**	**1.097 (1.071 to 1.122)**
Unknown	5.339 (5.240 to 5.439)	4.618 (4.502 to 4.734)	6.844 (6.208 to 7.480)	5.131 (4.974 to 5.287)	5.796 (5.646 to 5.945)	-0.016 (-0.032 to -0.001)	0.032 (0.021 to 0.042)	**0.048 (0.029 to 0.067)**	**1.145 (1.110 to 1.181)**
Current smoking status									
No	6.121 (6.055 to 6.187)	5.991 (5.926 to 6.056)	6.151 (6.086 to 6.215)	5.812 (5.735 to 5.889)	6.267 (6.190 to 6.345)	-0.013 (-0.019 to -0.007)	0.020 (0.015 to 0.025)	**0.033 (0.025 to 0.041)**	**1.041 (1.026 to 1.056)**
Yes	5.707 (5.590 to 5.824)	5.564 (5.443 to 5.686)	6.603 (6.464 to 6.743)	6.086 (5.915 to 6.257)	6.906 (6.723 to 7.088)	0.050 (0.038 to 0.063)	0.034 (0.023 to 0.044)	-0.017 (-0.033 to 0.000)	**1.172 (1.137 to 1.209)**
Alcohol consumption, days/month									
0	6.984 (6.896 to 7.073)	6.827 (6.737 to 6.916)	7.226 (7.134 to 7.318)	6.799 (6.691 to 6.906)	7.130 (7.021 to 7.239)	0.000 (-0.008 to 0.008)	0.013 (0.007 to 0.019)	**0.013 (0.003 to 0.022)**	1.009 (0.983 to 1.037)
1-4	5.083 (4.988 to 5.179)	5.029 (4.933 to 5.124)	5.258 (5.161 to 5.356)	4.821 (4.704 to 4.939)	6.141 (5.992 to 6.290)	-0.008 (-0.019 to 0.003)	0.064 (0.055 to 0.073)	**0.072 (0.057 to 0.086)**	**1.225 (1.191 to 1.259)**
5-30	5.215 (5.098 to 5.332)	5.168 (5.054 to 5.283)	5.530 (5.413 to 5.646)	5.160 (5.019 to 5.302)	5.328 (5.208 to 5.448)	0.009 (-0.004 to 0.022)	0.008 (-0.001 to 0.017)	-0.001 (-0.016 to 0.015)	1.009 (0.983 to 1.037)
BMI group									
Under and normal	6.314 (6.234 to 6.395)	6.185 (6.103 to 6.268)	6.668 (6.581 to 6.755)	6.203 (6.092 to 6.313)	6.777 (6.668 to 6.887)	0.008 (0.000 to 0.016)	0.024 (0.017 to 0.030)	**0.015 (0.005 to 0.025)**	**1.071 (1.051 to 1.091)**
Over and obese	5.704 (5.622 to 5.785)	5.603 (5.523 to 5.684)	5.828 (5.749 to 5.907)	5.606 (5.515 to 5.697)	6.040 (5.946 to 6.134)	0.000 (-0.008 to 0.008)	0.020 (0.014 to 0.026)	**0.020 (0.010 to 0.030)**	**1.065 (1.046 to 1.085)**

Table 2. Continued

	Before the pandemic				During the pandemic	Sadness trend, β (95% CI)		Trend difference, β_{diff} (95% CI)	Before and during the COVID pandemic, OR (95% CI)
	2009-2011	2012-2014	2015-2017	2018-2019	2020-2021	Before the pandemic	During the pandemic		2020-2021 versus 2018-2019
Education background									
≤ High school	6.718 (6.644 to 6.792)	6.624 (6.548 to 6.699)	6.913 (6.835 to 6.990)	6.625 (6.532 to 6.719)	7.010 (6.914 to 7.106)	0.003 (-0.004 to 0.009)	0.015 (0.010 to 0.020)	**0.013 (0.004 to 0.021)**	**1.046 (1.029 to 1.062)**
≥ College	4.600 (4.512 to 4.689)	4.588 (4.502 to 4.673)	5.090 (5.003 to 5.177)	4.554 (4.451 to 4.656)	5.376 (5.270 to 5.481)	0.016 (0.005 to 0.026)	0.043 (0.036 to 0.051)	**0.028 (0.014 to 0.041)**	**1.145 (1.119 to 1.171)**
Occupational group									
White-collar	4.150 (4.039 to 4.261)	4.133 (4.025 to 4.241)	4.629 (4.516 to 4.742)	4.147 (4.012 to 4.281)	4.877 (4.736 to 5.018)	0.021 (0.006 to 0.036)	0.042 (0.031 to 0.054)	**0.022 (0.003 to 0.040)**	**1.147 (1.109 to 1.186)**
Blue-collar	4.766 (4.686 to 4.845)	4.718 (4.641 to 4.796)	5.037 (4.958 to 5.117)	4.642 (4.547 to 4.738)	5.154 (5.054 to 5.254)	0.004 (-0.006 to 0.013)	0.027 (0.020 to 0.035)	**0.024 (0.012 to 0.036)**	**1.076 (1.052 to 1.100)**
Unknown	8.262 (8.156 to 8.368)	8.348 (8.236 to 8.461)	8.639 (8.525 to 8.754)	8.182 (8.048 to 8.316)	8.504 (8.372 to 8.636)	0.005 (-0.004 to 0.013)	0.011 (0.004 to 0.017)	0.006 (-0.004 to 0.016)	1.018 (0.999 to 1.037)
Marital status									
Married	5.307 (5.244 to 5.371)	5.150 (5.087 to 5.214)	5.302 (5.237 to 5.367)	4.985 (4.906 to 5.063)	5.445 (5.364 to 5.527)	-0.016 (-0.023 to -0.009)	0.023 (0.018 to 0.029)	**0.039 (0.030 to 0.049)**	**1.049 (1.031 to 1.067)**
Single	7.851 (7.729 to 7.973)	7.823 (7.699 to 7.946)	8.421 (8.298 to 8.544)	7.804 (7.660 to 7.947)	8.200 (8.062 to 8.339)	0.012 (0.002 to 0.021)	0.013 (0.007 to 0.020)	0.002 (-0.010 to 0.013)	**1.028 (1.008 to 1.049)**

Abbreviation: BMI, body mass index; CI, confidence interval; OR, odds ratio.
The bold numbers indicate a significant difference (p <0.05).

Table 3. Nationwide trends in prevalence of counseling for sadness status from Korean adults in Community Health Survey, 2009-2021

	Before the pandemic				During the pandemic	Counseling for sadness trend, β (95% CI)		Trend difference, β_{diff} (95% CI)	Before and during the COVID pandemic, OR (95% CI)
	2009-2011	2012-2014	2015-2017	2018-2019	2020 2021	Before the pandemic	During the pandemic		2020-2021 versus 2018-2019
Overall	0.941 (0.917 to 0.964)	0.991 (0.966 to 1.015)	1.123 (1.098 to 1.149)	1.233 (1.201 to 1.266)	1.486 (1.450 to 1.521)	0.109 (0.096 to 0.122)	0.047 (0.038 to 0.056)	**-0.062 (-0.078 to -0.046)**	**1.412 (1.374 to 1.451)**
Income									
< 3 million won	1.218 (0.000 to 1.259)	1.376 (0.000 to 1.419)	1.431 (0.000 to 1.470)	1.742 (0.000 to 1.805)	1.998 (0.000 to 2.064)	0.114 (0.097 to 0.130)	0.035 (0.022 to 0.047)	**-0.079 (-0.099 to -0.058)**	**1.428 (1.375 to 1.482)**
≥ 3 million won	0.647 (0.611 to 0.683)	0.670 (0.637 to 0.703)	0.761 (0.730 to 0.793)	0.862 (0.820 to 0.903)	1.111 (1.063 to 1.158)	0.109 (0.084 to 0.134)	0.064 (0.048 to 0.080)	**-0.045 (-0.074 to -0.015)**	**1.518 (1.445 to 1.595)**
Unknown	0.829 (0.789 to 0.869)	0.735 (0.688 to 0.783)	1.256 (0.976 to 1.537)	1.080 (1.007 to 1.153)	1.309 (1.236 to 1.382)	0.122 (0.085 to 0.160)	0.048 (0.026 to 0.069)	**-0.075 (-0.118 to -0.031)**	**1.541 (1.444 to 1.646)**
Current smoking status									
No	0.990 (0.963 to 1.017)	1.016 (0.989 to 1.044)	1.110 (1.082 to 1.138)	1.209 (1.173 to 1.245)	1.442 (1.404 to 1.480)	0.079 (0.064 to 0.094)	0.044 (0.034 to 0.054)	**-0.035 (-0.052 to -0.017)**	**1.351 (1.311 to 1.393)**
Yes	0.774 (0.730 to 0.818)	0.894 (0.844 to 0.944)	1.181 (1.120 to 1.241)	1.350 (1.267 to 1.433)	1.706 (1.612 to 1.799)	0.226 (0.197 to 0.256)	0.059 (0.038 to 0.080)	**-0.167 (-0.204 to -0.131)**	**1.719 (1.615 to 1.830)**
Alcohol consumption, days/month									
0	1.247 (0.000 to 1.285)	1.277 (0.000 to 1.317)	1.409 (0.000 to 1.451)	1.480 (0.000 to 1.531)	1.677 (0.000 to 1.731)	0.072 (0.055 to 0.090)	0.047 (0.028 to 0.066)	-0.025 (-0.051 to 0.001)	**1.533 (1.446 to 1.625)**
1–4	0.679 (0.643 to 0.715)	0.755 (0.717 to 0.793)	0.887 (0.846 to 0.928)	1.016 (0.961 to 1.072)	1.474 (1.399 to 1.549)	0.157 (0.130 to 0.184)	0.094 (0.075 to 0.112)	**-0.063 (-0.096 to -0.030)**	**1.819 (1.718 to 1.927)**
5–30	0.624 (0.582 to 0.665)	0.715 (0.671 to 0.759)	0.858 (0.811 to 0.905)	0.976 (0.913 to 1.038)	1.187 (1.129 to 1.245)	0.174 (0.141 to 0.207)	0.047 (0.028 to 0.066)	**-0.127 (-0.165 to -0.089)**	**1.533 (1.446 to 1.625)**

Table 3. Continued

	Before the pandemic				During the pandemic	Counseling for sadness trend, β (95% CI)		Trend difference, β_{diff} (95% CI)	Before and during the COVID pandemic, OR (95% CI)
	2009-2011	2012-2014	2015-2017	2018-2019	2020 2021	2009-2011		2012-2014	2015-2017
BMI group									
Under and normal	0.949 (0.917 to 0.982)	1.018 (0.984 to 1.052)	1.162 (1.125 to 1.200)	1.271 (1.220 to 1.322)	1.559 (1.505 to 1.613)	0.114 (0.096 to 0.132)	0.051 (0.038 to 0.065)	**-0.063 (-0.085 to -0.040)**	**1.457 (1.401 to 1.516)**
Over and obese	0.931 (0.897 to 0.965)	0.962 (0.928 to 0.996)	1.087 (1.052 to 1.122)	1.206 (1.163 to 1.249)	1.425 (1.378 to 1.472)	0.106 (0.087 to 0.125)	0.042 (0.030 to 0.054)	**-0.064 (-0.087 to -0.041)**	**1.378 (1.327 to 1.431)**
Education background									
≤ High school	1.086 (1.056 to 1.117)	1.149 (1.116 to 1.181)	1.267 (1.232 to 1.301)	1.343 (1.299 to 1.386)	1.547 (1.500 to 1.593)	0.086 (0.071 to 0.102)	0.036 (0.025 to 0.047)	**-0.050 (-0.070 to -0.031)**	**1.298 (1.255 to 1.342)**
≥ College	0.641 (0.607 to 0.675)	0.704 (0.669 to 0.738)	0.882 (0.845 to 0.919)	1.047 (0.997 to 1.097)	1.390 (1.335 to 1.445)	0.195 (0.169 to 0.220)	0.071 (0.055 to 0.086)	**-0.124 (-0.154 to -0.095)**	**1.741 (1.662 to 1.824)**
Occupational group									
White-collar	0.482 (0.000 to 0.520)	0.529 (0.000 to 0.569)	0.701 (0.000 to 0.745)	0.836 (0.000 to 0.897)	1.192 (0.000 to 1.263)	0.221 (0.183 to 0.260)	0.088 (0.065 to 0.111)	**-0.133 (-0.178 to -0.088)**	**1.934 (1.803 to 2.075)**
Blue-collar	0.609 (0.580 to 0.638)	0.668 (0.639 to 0.698)	0.766 (0.734 to 0.798)	0.799 (0.759 to 0.840)	0.992 (0.948 to 1.037)	0.111 (0.086 to 0.135)	0.054 (0.037 to 0.071)	**-0.056 (-0.086 to -0.027)**	**1.416 (1.345 to 1.490)**
Unknown	1.513 (1.466 to 1.560)	1.646 (1.594 to 1.698)	1.809 (1.755 to 1.863)	1.950 (1.882 to 2.017)	2.184 (2.115 to 2.253)	0.103 (0.085 to 0.120)	0.029 (0.017 to 0.041)	**-0.074 (-0.095 to -0.053)**	**1.288 (1.242 to 1.335)**
Marital status									
Married	0.837 (0.811 to 0.863)	0.840 (0.814 to 0.867)	0.918 (0.891 to 0.946)	0.993 (0.958 to 1.029)	1.153 (1.114 to 1.191)	0.068 (0.051 to 0.085)	0.038 (0.025 to 0.050)	**-0.030 (-0.051 to -0.009)**	**1.302 (1.255 to 1.352)**
Single	1.204 (1.154 to 1.253)	1.375 (1.321 to 1.428)	1.604 (1.548 to 1.659)	1.767 (1.697 to 1.838)	2.142 (2.069 to 2.215)	0.154 (0.133 to 0.175)	0.048 (0.035 to 0.062)	**-0.106 (-0.130 to -0.081)**	**1.469 (1.412 to 1.529)**

Abbreviation: BMI, body mass index; CI, confidence interval; OR, odds ratio.
The bold numbers indicate a significant difference (p <0.05).

Table 4. Nationwide trends in average sleep time from Korean adults in Community Health Survey, 2009-2021.

	Before the pandemic				During the pandemic	Sleep time trend, β (95% CI)		Trend difference, β_{diff} (95% CI)
	2009-2011	2012-2014	2015-2017	2018-2019	2020-2021	Before the pandemic	During the pandemic	
Overall	6.710 (6.707 to 6.713)	6.628 (6.625 to 6.631)	6.556 (6.553 to 6.558)	6.628 (6.624 to 6.631)	6.773 (6.770 to 6.777)	-0.028 (-0.029 to -0.027)	**0.023 (0.022 to 0.024)**	**0.051 (0.050 to 0.052)**
Income								
< 3 million won	6.685 (6.680 to 6.690)	6.599 (6.594 to 6.604)	6.539 (6.535 to 6.544)	6.592 (6.586 to 6.599)	6.649 (6.643 to 6.656)	-0.024 (-0.026 to -0.023)	**0.007 (0.006 to 0.008)**	**0.031 (0.030 to 0.033)**
≥ 3 million won	6.698 (6.693 to 6.703)	6.630 (6.626 to 6.635)	6.575 (6.571 to 6.579)	6.645 (6.640 to 6.650)	6.861 (6.856 to 6.866)	-0.020 (-0.022 to -0.018)	**0.042 (0.040 to 0.043)**	**0.062 (0.059 to 0.064)**
Unknown	6.756 (6.751 to 6.762)	6.690 (6.683 to 6.696)	6.504 (6.473 to 6.535)	6.658 (6.650 to 6.667)	6.822 (6.814 to 6.830)	-0.031 (-0.033 to -0.028)	**0.027 (0.025 to 0.029)**	**0.058 (0.055 to 0.061)**
Current smoking status								
No	6.714 (6.710 to 6.717)	6.631 (6.627 to 6.634)	6.559 (6.556 to 6.563)	6.629 (6.625 to 6.633)	6.761 (6.757 to 6.765)	-0.028 (-0.029 to -0.027)	**0.021 (0.020 to 0.021)**	**0.048 (0.047 to 0.050)**
Yes	6.698 (6.692 to 6.704)	6.619 (6.612 to 6.625)	6.539 (6.532 to 6.546)	6.620 (6.611 to 6.629)	6.837 (6.828 to 6.846)	-0.030 (-0.033 to -0.028)	**0.034 (0.032 to 0.036)**	**0.064 (0.061 to 0.068)**
Alcohol consumption, days/month								
0	6.714 (6.710 to 6.719)	6.621 (6.617 to 6.626)	6.535 (6.531 to 6.540)	6.605 (6.599 to 6.610)	6.690 (6.684 to 6.696)	-0.031 (-0.033 to -0.030)	**0.012 (0.011 to 0.013)**	**0.043 (0.041 to 0.045)**
1–4	6.731 (6.726 to 6.736)	6.658 (6.654 to 6.663)	6.594 (6.590 to 6.599)	6.672 (6.666 to 6.679)	6.851 (6.843 to 6.858)	-0.027 (-0.029 to -0.025)	**0.032 (0.031 to 0.034)**	**0.059 (0.057 to 0.062)**
5–30	6.671 (6.665 to 6.677)	6.600 (6.594 to 6.606)	6.544 (6.537 to 6.550)	6.618 (6.610 to 6.626)	6.850 (6.844 to 6.856)	-0.021 (-0.023 to -0.018)	**0.040 (0.038 to 0.042)**	**0.061 (0.058 to 0.064)**

Table 4. Continued

	Before the pandemic				During the pandemic	Sleep time trend, β (95% CI)		Trend difference, β_{diff} (95% CI)
	2009-2011	2012-2014	2015-2017	2018-2019		2009-2011	2012-2014	2015-2017
BMI								
Under and normal	6.754 (6.750 to 6.758)	6.671 (6.666 to 6.675)	6.598 (6.594 to 6.603)	6.682 (6.676 to 6.688)	6.821 (6.815 to 6.826)	-0.027 (-0.028 to -0.025)	**0.021 (0.020 to 0.022)**	**0.048 (0.046 to 0.050)**
Over and obese	6.661 (6.657 to 6.665)	6.584 (6.579 to 6.588)	6.515 (6.511 to 6.519)	6.587 (6.582 to 6.592)	6.735 (6.730 to 6.740)	-0.025 (-0.027 to -0.024)	**0.024 (0.023 to 0.025)**	**0.049 (0.047 to 0.051)**
Education background								
≤High school	6.696 (6.692 to 6.700)	6.603 (6.599 to 6.607)	6.519 (6.515 to 6.523)	6.586 (6.581 to 6.591)	6.662 (6.657 to 6.667)	-0.032 (-0.033 to -0.031)	**0.010 (0.009 to 0.011)**	**0.042 (0.041 to 0.044)**
≥College	6.740 (6.735 to 6.744)	6.673 (6.669 to 6.678)	6.617 (6.612 to 6.621)	6.698 (6.692 to 6.703)	6.948 (6.943 to 6.953)	-0.022 (-0.024 to -0.019)	**0.051 (0.049 to 0.052)**	**0.072 (0.070 to 0.075)**
Occupational group								
White-collar	6.629 (6.623 to 6.635)	6.575 (6.569 to 6.580)	6.527 (6.522 to 6.532)	6.603 (6.596 to 6.610)	6.874 (6.867 to 6.880)	-0.019 (-0.022 to -0.016)	**0.066 (0.063 to 0.068)**	**0.085 (0.081 to 0.089)**
Blue-collar	6.669 (6.665 to 6.673)	6.600 (6.596 to 6.604)	6.525 (6.520 to 6.529)	6.585 (6.579 to 6.590)	6.728 (6.722 to 6.733)	-0.030 (-0.032 to -0.029)	**0.025 (0.023 to 0.026)**	**0.055 (0.053 to 0.057)**
Unknown	6.793 (6.787 to 6.798)	6.693 (6.687 to 6.698)	6.610 (6.604 to 6.616)	6.690 (6.683 to 6.697)	6.771 (6.764 to 6.777)	-0.027 (-0.029 to -0.026)	**0.010 (0.009 to 0.011)**	**0.037 (0.035 to 0.039)**
Marital status,								
Married	6.712 (6.708 to 6.715)	6.632 (6.628 to 6.635)	6.563 (6.560 to 6.567)	6.623 (6.619 to 6.628)	6.742 (6.738 to 6.746)	-0.031 (-0.032 to -0.030)	**0.020 (0.019 to 0.021)**	**0.051 (0.049 to 0.053)**
Single	6.706 (6.700 to 6.712)	6.618 (6.612 to 6.625)	6.537 (6.531 to 6.543)	6.637 (6.630 to 6.644)	6.835 (6.828 to 6.842)	-0.023 (-0.025 to -0.021)	**0.026 (0.025 to 0.028)**	**0.049 (0.047 to 0.051)**

Abbreviation: BMI, body mass index; CI, confidence interval; OR, odds ratio.
The bold numbers indicate a significant difference ($p < 0.05$)

mental health of people globally. Sleep problems including reduced sleep time and high levels of psychological distress such as depression and anxiety have been observed in several studies during the COVID-19 pandemic [14, 15]. Findings in this study suggest the average sleep time and sadness among adults both have increased during the pandemic period, and the changes are closely related.

4.2 Comparison to previous studies

There are other studies that have also used the KCHS data to compare the status of depression and sleep time of adults before and after COVID-19 [16, 17]. However, these studies made comparisons simply between 2019 and 2020 or investigated measures of 2020 only, and could not determine whether the changes were due to the COVID-19 pandemic or simply a fluctuation of rates as continuations of previous trends. By observing from 2009 to the mid/early pandemic, we were able to determine and clarify the direction and changes in trend through a prolonged period. The KCHS is a large-scale database which report the health-related results and lifestyle characteristics of adults by administering the survey to individuals across all country regions. The database is unique in that it collects various health data continuously and annually since the survey started in 2008. Unlike other related studies[18], this study was able to investigate depression and sleep related trends on a large scale from 2009 to 2021.

4.3 Plausible underlying mechanisms

The increase trend in the prevalence of sadness during the pandemic was clear among most of the populations. The increase of depression (or sadness) during the pandemic can have several mechanisms. First, in response to the COVID-19 pandemic, governments around the world encouraged and requested social distancing, closures of specific businesses, schools and public space, and banned large gatherings in such areas. This led to the decrease in social encounters and meetings, eventually to the isolation of members in vulnerable populations[19]. Social isolation and loneliness are known to be closely related with mental health problems including depression [20]. Also, inadequate accessibility to resources, frustration, and boredom during quarantines might have led to mental health problems [21]. Furthermore, the concerns and fear of COVID-19 infection might have contributed to symptoms of depression amongst populations. Those who were infected experienced discrimination and isolation as well as the symptoms of disease, and those who were not infected experienced worry in relation to infection[22]. Citizens were warned of the pandemic through massive information via social media which exacerbated the fear[23]. Importantly, literature suggests that fear of infection lead to an increase in depressive symptoms[24]. Global socioeconomic crisis, general changes in culture and politics, and inaccessibility to medical services are other possible factors contributing to the result[25].

Counseling is an important means to decrease anxiety and depression among patients[26]. People who received counseling for depression have decreased in percent changes, even though depression has increased in rate in our findings. Elaborating, the ascending slope of depression exceeds that of counseling for depression entering the COVID-19 pandemic. This brings

concern that those who gained depression during the pandemic did not or could not achieve appropriate counseling for such symptoms. A plausible reason for such results may be the lockdown and social-distancing policies, and the following reduced accessibility to medical services during the pandemic. Accessibility to healthcare including mental health have reduced in significant manners during the pandemic [27]. Also, the concern for infection led people to stay home, decreasing the willingness to get counseling for depression[28, 29]. Unmet needs for mental health services caused serious impact on vulnerable populations and those who had mental disorder from before.

Interestingly, average sleep time of adults increased than expected during the COVID-19 pandemic. Considering the pandemic has brought lockdown for prolonged periods, staying indoors, reduced physical activity, and reduced sunlight exposure, are likely to have increased the average time of sleep of individuals[30]. A report suggests the lack of social zeitgebers during the pandemic might be a reason[31]. People lost regular work schedules and social activities, which were defining generally the sleep time of the active population. The least percentage change in sleep time for the elderly (above 60 years old) among the age group supports the mechanism, in our study.

4.4 Policy implication

Governments must provide a system for adequate mental health services. To note psychiatry consultations might be less accessible, interventions such as digital mental health service is required[32]. Health professionals should consider individualized precision medicine, taking into account vulnerable populations such as women, low-income individuals, and those with lower levels of education[33]. Also, diagnosis and treatment of depression, as well as the monitoring of psycho-physiological well-being including sleep time of patients amid the pandemic should be taken into public concern.

4.5 Strengths and limitations

However, large-scale studies regarding the variables have been used in self-reported questionnaires generally. This study is a nationwide study, showing status of people living in South Korea. The findings of our study should be replicated in countries other than Korea[34]. The findings of our study and the plausible mechanism discussed above must be assessed in further studies internationally. Since the study includes large-scale survey, however, the findings will gain scientific importance if results attain reproducibility. Also, it is possible that the changes of variables entering the pandemic were simply a fluctuating trend. However, numerous other related studies investigating the trends in large-scale supports that the present[35]. Lastly, the differences in stance of restriction and quarantine policies between nations must be considered to discuss further values of such findings.

5. Conclusion

To the best our knowledge, this is the first long-term, large-scale, and population-based study to analyze the changes in prolonged trends of sadness, counseling for sadness, and sleep

time among adults before and during the COVID-19 pandemic. We compared the trends regarding the three variables during the early/mid pandemic with the trends across 13 years preceding the COVID-19 pandemic. The prevalence of sadness remained stable before the pandemic, but the slope was positive during the pandemic, showing an increase in total prevalence entering the pandemic. However, the prevalence of individuals who had counseled for sadness gradually increased less than expected during the pandemic. The average sleep time of Korean adults showed a decline before the pandemic, but increased during the pandemic. Our research suggests that, during the pandemic, individual policy strategy for the psycho-physiological aspect should be addressed as a public issue.

Capsule Summary

This is the first long-term, large-scale, and population-based study to analyze the changes in prolonged trends of sadness, counseling for sadness, and sleep time among adults before and during the COVID-19 pandemic.

Patient and public involvement

No patients were directly involved in designing the research question or in conducting the research. No patients were asked for advice on interpretation or writing up the results. There are no plans to involve patients or relevant patient community in dissemination at this moment.

Transparency statement

The leading author (Dr. AK) are an honest, accurate, and transparent account of the study being reported.

Acknowledgements

We published the preliminary results in the Asian Journal of Psychiatry.

Contributors

Dr AK had full access to all of the data in the study and took responsibility for the integrity of the data and the accuracy of the data analysis. All authors approved the final version before submission. All authors made substantial contributions to all of the following: (1) the conception and design of the study, or acquisition of data, and interpretation of data, (2) drafting the article or revising it critically for important intellectual content, (3) final approval of the version to be submitted. The corresponding author attests that all listed authors meet authorship criteria and that no others meeting the criteria have been omitted.

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conduct of the study; collection, management, analysis, or interpretation of the data; preparation, review, or approval of the manuscript; and the decision to submit the manuscript for publication.

Conflicts of Interest

All authors state that they have no actual or potential conflict of interest including any financial, personal, or other relationships with other people or organizations.

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